TIGER Burned Brightly in JAMIC

The Transition From Ignition to Flame Growth Under External Radiation in 3D (TIGER-3D) experiment, which is slated to fly aboard the International Space Station, conducted a series of highly successful tests in collaboration with the University of Hokkaido using Japan's 10-sec JAMIC drop tower. The tests were conducted to test engineering versions of advanced flight diagnostics such as an infrared camera for detailed surface temperature measurements and an infrared spectroscopic array for gas-phase species concentrations and temperatures based on detailed spectral emissions in the near infrared.

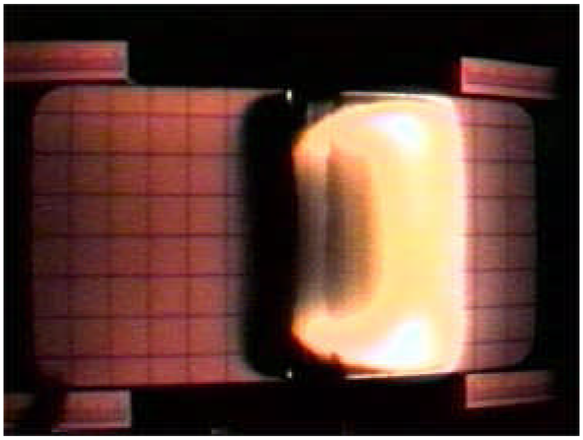
Shown in the top figure is a visible light image and in the bottom figure is an infrared image at 3.8 mm obtained during the microgravity tests. The images show flames burning across cellulose samples against a slow wind of a few centimeters per second (wind is from right to left). These flow velocities are typical of spacecraft ventilation systems that provide fresh air for the astronauts. The samples are ignited across the center with a hot wire, and the flame is allowed to spread upwind and/or downwind. As these images show, the flames prefer to spread upwind, *into* the fresh air, which is the exact opposite of flames on Earth, which spread much faster downwind, or *with* the airflow, as in forest fires.

These experiments show that fire safety aboard spacecraft cannot be extrapolated from fire safety on Earth, and must be studied carefully to develop an accurate understanding of fire behavior under the conditions found aboard spacecraft.

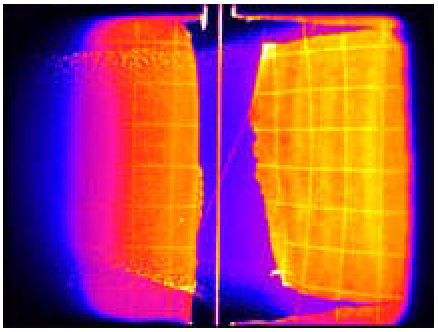
The fire safety strategy in a spacecraft is

1. To detect any fire as early as possible
2. To keep any fire as small as possible, and
3. To extinguish any fire as quickly as possible

This suggests that a material that undergoes a momentary ignition but then extinguishes might be tolerable, but a material that permits a transition to flame spread would significantly increase the fire hazard in a spacecraft. If the transition does not take place, fire growth does not occur. Therefore, it is critical to understand what process controls the transition from ignition to subsequent flame spread both upstream and downstream. Furthermore, if the transition occurs, it is important to be able to predict subsequent flame growth from the ignited area. This would characterize the potential fire hazard by calculating the heat-release rate, which is one of the most important properties in expressing the size of a fire.



Visible image of flame spread over cellulose sheet. 1-cm-square grid pattern on sample.



Infrared image at 3.8 mm of cellulose radiant heat loss as it pyrolizes beneath the flame. Soot from the flame can be seen streaming from the flame zone as well. The igniter wire is in the center of the image.

Find out more about this research (http://www.fire.nist.gov/bfrlpubs/fire99/PDF/f99126.pdf)

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